copper and silver, in all proportions, have the same conducting powers with each of those metals separately; while in alloys of tin and lead, the heat evolved is a mean of that of the heats evolved from each metal separately, taking into account the relative weights of each metal present in the alloy.

He observes, further, that very small quantities of alloy influence materially the conducting power. Thus he found that wires, drawn from foreign gold coins, reputed to be very pure, conducted much worse than when drawn from the same gold refined.

The substitution of a flattened for a cylindrical wire, or the separation of the latter into four smaller wires, were found to have no influence on the quantities of heat developed.

On the Expediency of assigning Specific Names to all such Functions of simple Elements as represent definite physical Properties; with the Suggestion of a new Term in Mechanics; illustrated by an Investigation of the Machine moved by recoil, and also by some Observations on the Steam Engine. *By* Davies Gilbert, *Esq. M.P. V.P.R.S. &c.* Read January 25, 1827. [*Phil. Trans.* 1827, *p.* 25.]

The author commences this paper by stating the necessity of distinguishing by separate appellations all such functions as measure the intensity of physical properties, which he considers rendered obvious by a reference to the controversy respecting motion. The subject of this controversy, he observes, was the measure of motion itself, it being contended on one hand that the motion of a body is always proportional to its weight multiplied by its velocity; this opinion being supported by reference to the properties of the common centre of gravity of systems, &c.; while on the other hand the affections of elastic bodies in collision, and the general law of the conservation of living or active forces, were adduced in support of the latter measure. No sooner, however, were the terms "momentum" and "impetus" introduced into the science of mechanics, than the opinions of the contending parties were reconciled by the removal of every ground of dispute.

In the Bakerian lecture on the force of percussion, read to this Society in 1806, he observes, it is remarked, that neither impetus nor momentum are usually correct measures of the effective action of machines. The criterion of this is the force exerted, multiplied by the space through which it acts, and this measure numerically expressed has been denominated DUTY by Mr. Watt; and the raising of one pound one foot high has been by him made the dynamic unit; according to which estimate, the *duty* performed by one bushel of coals, of 84 pounds, has been found to vary from 30 to 50 millions of such units, according to the nature of the engine, and the mode of combustion. To the measure or function represented by the force applied, multiplied by the space through which it acts, the author, however, proposes to give the name *efficiency*, retaining the word *duty* for a similar function, indicative of the work performed; and by a

comparison of these two functions, viz. the efficiency expended on, and the duty performed by, any machine, an exact measure of its intrinsic work will be obtained.

The author then proceeds to instance the utility of this new term in investigating the mechanical value of the recoil-engine; and by an algebraic process, taking every thing most favourable to the engine, arrives at the conclusion that the duty cannot, even in the best state of its action, materially exceed half the efficiency, and that in consequence it can never be used with advantage, the water-wheel and the pressure-engine offering much greater duties; while the wheel possesses the advantage of preserving a uniformity of efficiency during its whole action, which is not the case with the recoil-engine. And these considerations lead him to remark on the impossibility of carrying into effect a plan proposed by some eminent engineers for applying steam on a principle of recoil.

To estimate the efficiency of steam acting uniformly with its entire force, the author assumes from experience that a bushel of coals can convert into steam 14 cubic feet of water, occupying 1330 times that space in the state of steam, and therefore lifting an atmosphere incumbent on the surface of the water uniformly to 1330 times its depth; thus giving an efficiency of about 39 millions of pounds, raised one foot high. From this he concludes (all deductions made), 30 millions would probably be the utmost attainable limit of duty, but for two expedients; 1st, causing the steam to act expansively, after exerting its whole force through a certain part of the cylinder; 2ndly, raising its temperature, by an increased expense of fuel, much above 212°.

Both these means are considered, and occasion is taken to compare the efficacy of the methods invented by Messrs. Watt and Hornblower for the former purpose, the preference in point of simplicity and advantage being given however to the former. With regard to the latter, it is concluded that in certain cases, advantage is really gained by the use of strong steam. The author then alludes, with approbation, to a method recently attempted, where a small quantity of water is forced at each stroke into a minute boiler; presenting, however, a very large surface, in proportion to its capacity, and kept at an equable high temperature by immersion in fused metal. But he considers the greatest hopes of increased power to rest on the application to mechanical purposes of some fluid more elastic than the vapour of water, according to the suggestion of the President, in the Philosophical Transactions for 1823.

The author concludes this paper by a statement of the duties actually performed by the engines in Cornwall; from which it appears that several of the large engines there at work are actually performing a duty greater than the whole efficiency of the steam, unaided by expansive working or high pressure, on the assumptions here made; while others, apparently similar in every respect, fail of performing half that duty,—and no satisfactory cause has been assigned for that important difference.